

5. A shunt generator gives 100 A at a terminal voltage of 100 V. The speed of the generator is 1200 r.p.m. The armature resistance is 0.035Ω and the field resistance is 50Ω .

Find:

- i. The field current (4 marks)
- ii. The armature current (4 marks)
- iii. The armature voltage-drop (4 marks)
- iv. The E.M.F generated (4 marks)
- v. The speed of the machine when run as motor taking 1.2 A at a voltage of 100 V. (4 marks)

6. Three similar coils each having a resistance of 9Ω and inductive reactance of 12Ω are connected in Delta to a 400 V 50 Hz three-phase supply.

- a) Draw a diagram showing the connected load. (4 marks)
- b) Calculate:
 - i. the line current (2 marks)
 - ii. the power factor (2 marks)
 - iii. the total Apparent Power (2 marks)
 - iv. the total Active Power (2 marks)
- c) If the coils are re-connected in Star, calculate:
 - i. the line current (2 marks)
 - ii. the power factor (2 marks)
 - iii. the total Apparent Power (2 marks)
 - iv. the total Active Power (2 marks)

END OF PAPER

EXAMINATION: AUTHORISATION B
February 2019

Paper I (Theory)

Time Allowed: 3 Hrs

**WRITE ALL YOUR WORK IN THE ANSWER BOOK PROVIDED.
EVERY ANSWER SHOULD INCLUDE ALL WORKINGS, NECESSARY
DIAGRAMS AND FORMULAE.**

START EACH ANSWER ON A FRESH PAGE.

Answer any FIVE Questions

1. a) A 150 kVA, three-phase, delta-star connected step-down transformer has a phase-turns ratio of 47.8 to 1. The primary is connected to an 11 kV, three-phase supply.
- i) Calculate the secondary phase voltage of the transformer. **(2 marks)**
 - ii) Calculate the secondary line voltage of the transformer. **(2 marks)**
 - iii) Calculate the primary line current of the transformer. **(2 marks)**
 - iv) Calculate the secondary line current of the transformer. **(2 marks)**
 - v) A three-phase, 25 kW balanced load with a power factor of 0.75 is supplied directly from the secondary side of the transformer. Calculate the load current drawn by the load. **(2 marks)**
- b) An earth loop impedance test result of 0.27Ω has been recorded on a 230 V final sub-circuit supplying socket outlets in a low voltage electrical installation. Calculate the fault current that will flow if a short circuit occurs on the final sub-circuit. **(5 marks)**
- c) A low voltage electrical installation has an earth fault loop impedance of 0.1Ω when measured at the switchboard. Calculate the prospective short circuit current of the electrical installation. **(5 marks)**
2. a) What test would be carried out to determine if the rupturing capacity of an HRC fuse is compatible with the prospective short circuit current of an electrical installation? **(3 marks)**
- b) A three-phase fixed-wired electrical equipment has been operating normally and has been isolated from an adjacent isolating switch. Two phases were found to be live when voltage testing was carried out at the equipment terminals. State what fault has occurred. **(3 marks)**
- c) A three-phase, 400V commercial oven has 3 MIMS elements connected in star. Each element is rated at 6 kW. Calculate the phase current drawn by the oven. **(2 marks)**
- d) A 12 V d.c. supply with an internal resistance of 0.2Ω is installed to supply 9V lights for an emergency lighting circuit. All lights are connected in parallel across the supply. Each light in the circuit draws 1.5A at the rated voltage of 9V. Calculate the maximum number of lights that can be used in the emergency lighting circuit. **(2 marks)**

- e) A new factory has been constructed that incorporates some imported machinery that operates at a standard low voltage. A dedicated supply is required for this machinery. A 300 kVA, three-phase, delta-star transformer will be used. The characteristics of the transformer are:
- a turns ratio of 137.5 to 1
 - a primary voltage of 33 kV
- i. Calculate the secondary phase voltage **(2 marks)**
 - ii. Calculate the secondary line voltage **(2 marks)**
 - iii. Calculate the primary line current **(2 marks)**
 - iv. Calculate the maximum secondary line current the transformer can deliver under full load conditions **(2 marks)**
 - v. When the load on a transformer changes from no-load to full-load a voltage drop occurs at the secondary terminals. Is this voltage drop normal and state the reason why? **(2 marks)**
3. a) What is the advantage of connecting the low voltage winding of a transformer in Star connection? **(4 marks)**
- b) The primary and secondary windings of a 600 kVA transformer have resistances of 0.62Ω and 0.0024Ω respectively. The primary and secondary voltages are 7500 V and 400 V respectively and the iron losses after performing an open circuit test were found to be 2.2 kW.
- Assuming that the load supplied by the transformer has a power factor of 0.8 lagging, Calculate the efficiency of the transformer:
- i. on full load **(8 marks)**
 - ii. on half load **(8 marks)**
4. Two watt-meters are used to measure the input of a 400 V three-phase motor which has a full load output of 20 h.p.
- The efficiency of the motor is 88% and its power factor is 0.8.
- a) Draw a neat diagram of the arrangement. **(4 marks)**
 - b) Find the reading on each of the watt-meters. **(8 marks)**
 - c) Find the full-load current. **(8 marks)**